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First checklist of the herpetofauna (Amphibia, Reptilia) of the Kapas and Gemia Islands, Peninsular Malaysia, South China Sea

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Abstract. Off the coast of Terengganu, Peninsular Malaysia, lie the Kapas and Gemia Islands. The biota, and particularly the herpetofauna, of these small, famous islands is poorly known. Opportunistic surveys were conducted on these islands during the dry and pre-monsoon periods using visual encounter surveys (VES) as the method to record the herpetofauna. The surveys recorded five species of amphibians from four genera and three families, and 16 species of reptiles from 15 genera and 10 families. This report represents the first checklist of the herpetofauna of the Kapas and Gemia Islands, Terengganu, and it shows the unrealized biodiversity of small offshore islands in the archipelagos of the South China Sea. More extensive surveys should be conducted in the future to get a more complete understanding of the herpetofauna inhabiting these small islands, which face anthropogenic disturbances.

Key words. Amphibians, conservation, insular, reptiles, Terengganu, tropical island

Syafiq MF, Badli-Sham BH, Aqmal-Naser M, Fahmi-Ahmad M, Quah ESH, Grismer LL, Ahmad AB (2025) First checklist of the herpetofauna (Amphibia, Reptilia) of the Kapas and Gemia Islands, Peninsular Malaysia, South China Sea. Check List 21 (2): 268–281. https://doi.org/10.15560/21.2.268

INTRODUCTION

Islands situated along the coast of Peninsular Malaysia in the South China Sea have highly diverse flora and fauna (e.g. Inger and Voris 2001; Leong and Grismer 2003; Grismer 2005a, 2005b, 2011b; Chan and Norhayati 2010; Grismer et al. 2011, 2014a; Pesiu et al. 2016; Hamza et al. 2016a, 2016b; Aqmal-Naser and Ahmad 2018; Aqmal-Naser et al. 2019; Badli-Sham et al. 2019a, 2019b; Fatihah-Syafiq et al. 2020). The isolation and unique characteristics of islands have prompted the evolution of many endemic forms, which is the case in many of Peninsular Malaysia's offshore islands (Grismer et al. 2003, 2004a, 2004b, 2006a, 2006b, 2011b; Grismer and Pan 2008; Grismer and Quah 2019). These endemic species represent a significant portion of the nation's biological diversity (Kier et al. 2009).

Herpetological works on some of the islands off the east coast of Peninsular Malaysia have revealed an astonishingly high diversity of terrestrial herpetofauna (Grismer et al. 2011), many of which are endemic to those islands (Das and Grismer 2003; Leong and Grismer 2004; Grismer 2006, 2011b; Grismer and Das 2006; Chan et al. 2011). Several studies, such as those on the Perhentian and Bidong islands, have resulted in the descriptions of new endemic insular species (Grismer and Chan 2008; Grismer et al. 2009, 2014b). However, herpetological inventories in this region are by no means complete, as the herpetofaunal diversity of some smaller islands remains unknown.

Kapas Island is a small island off mainland Terengganu. It is populated by residents who are mostly employed in tourism. To the north of Kapas lies another small island, Gemia Island, which is separated by a very narrow channel of approximately 300 m. A few studies have been conducted on Kapas Island, which largely focused on the marine ecosystem (Chan et al. 1988; Islam et al. 2016). Studies on the terrestrial biodiversity on these islands has been overlooked, and no extensive herpetofaunal records have been published for either island to date, except for a brief mention on the presence of the agamid, *Calotes versicolor* (Daudin, 1802) by Grismer (2011a) on Kapas Island.

The present study was carried out to survey and document the herpetofauna, including marine reptile species, that occur on Kapas and Gemia Islands. The gathered data are essential to better understand the composition and distribution of amphibian and reptilian species in the northeastern Peninsular Malaysia,

OPEN ACCESS

Academic editor: Jesse Grismer
Received: 17 January 2024
Accepted: 29 April 2024
Published: 12 March 2025

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especially in the state of Terengganu. We present herein the first report on the herpetofauna of Kapas and Gemia Islands, Terengganu, Peninsular Malaysia.

STUDY AREA

Kapas Island is a small island off the east coast of Terengganu (at center: 05.2190, 103.2649; WGS 84 datum), which has an area of approximately 2 km^2. It is an important tourist destination in the state of Terengganu (Figure 1). Chalets and resorts have been established for many years on the southern part of the island and along the coastline to the west to accommodate tourists. The landscape of Kapas Island consists of sandy beaches with some rocky areas lining some parts of its coast, while its interior is composed of hilly terrain covered in lowland dipterocarp forest with scattered outcroppings of granite boulders. In addition, there is a small ephemeral stream on the island, and the water is sourced from heavy rainfall during the transition of monsoons (Isa et al. 2014). During this period, the stream drains into the sea, while at other times it leaves behind several stagnant puddles. This ephemeral stream can be accessed through established forest trails, namely Berakit Trail, that transits the island across its middle and crosses through the hilly areas at the island's southern parts. Gemia Island is much smaller (~0.1 km^2) and lto the north of Kapas Island (at center: 05.2336, 103.2628; WGS 84 datum) (Figure 1). Gemia Island's topography is hilly and covered with lowland dipterocarp trees and coastal vegetation with a sandy beach on the southwestern part of the island.

METHODS

Surveys were conducted on the Kapas and Gemia Islands, Terengganu, Malaysia during the dry (10–13 April 2012 and 7–9 August 2018) and during pre-monsoon periods (9–11 October 2020 and 16 October 2020). Sampling was conducted during the day and at night by search parties comprising of up to four persons. During each session, approximately six hours (10:00–1600 h) were devoted for sampling during the day and three hours (20:00–23:00 h) for sampling at night. Collections were carried out using the visual encounter survey (VES) method. On Kapas Island, surveyed areas encompassed anthropomorphic areas such as around resort chalets and along accessible portions of the forest trail near the ephemeral stream, up to the hilly areas (<100 m a.s.l.). On Gemia Island, surveys were conducted along trails along the edges of the coastal forest, on rocky outcrops, and around the chalets. Suitable microhabitats for reptiles and amphibians were inspected, including under rocks, dead wood, and stumps, in rock crevices, tree buttresses, and leaf litter, and around temporary pools, rock pools, small streams, ditches, wooden huts, shrubs, and dense vegetation.

Captured individuals were examined and identified to species, photographed *in situ*, and released except for specimens of selected species which were collected as voucher specimens. Identification of species were based on Berry (1975) for amphibians, Auliya (2007) for freshwater turtles and tortoises, Das (2012) for snakes, and Grismer (2011a) for lizards. The most recent taxonomic nomenclature was followed based on Amphibian Species of the World database (Frost 2024) for amphibians, and The Reptile Database (Uetz et al. 2023) for reptiles. Voucher specimens were euthanized with benzocaine prior to fixation with

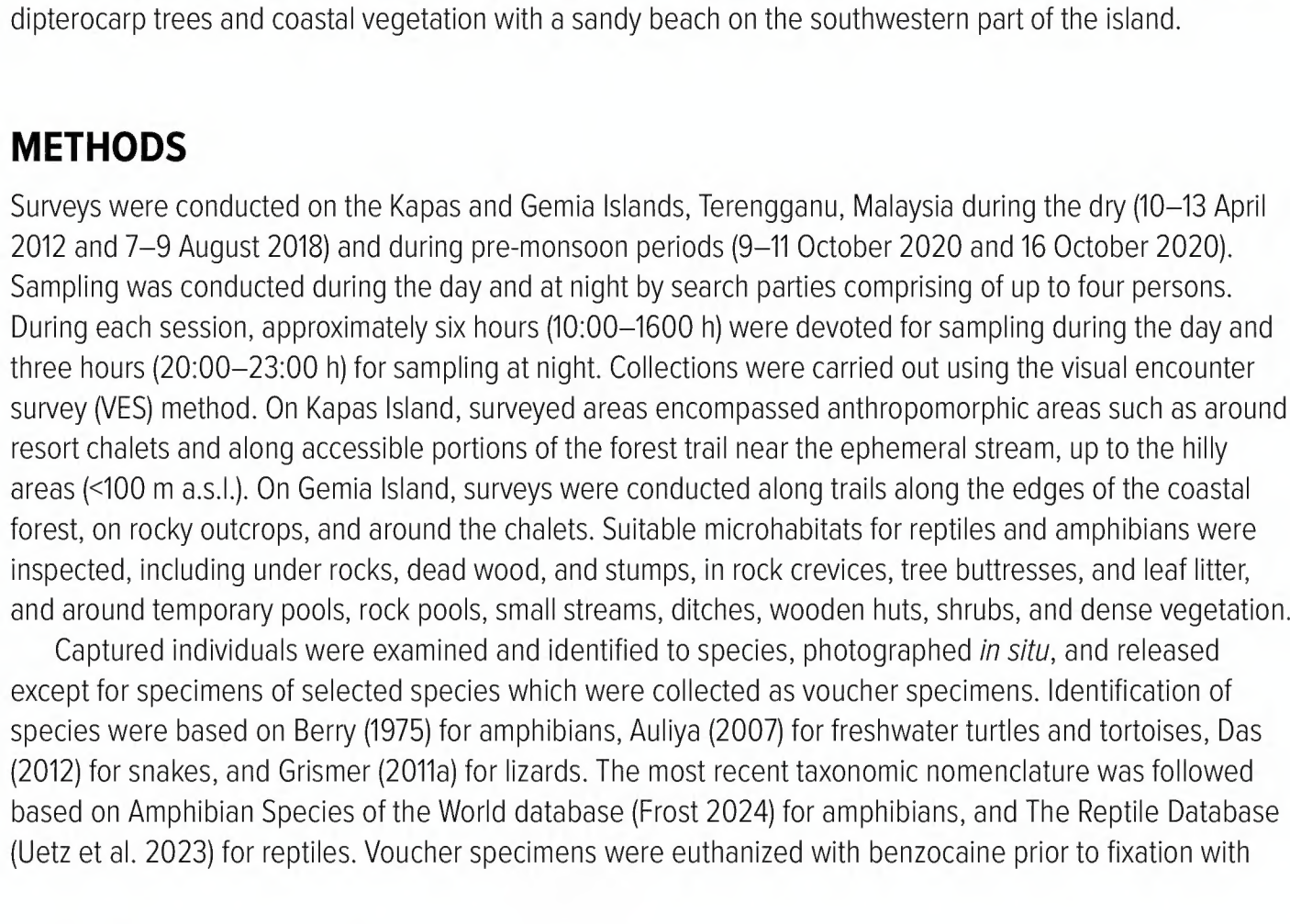

Figure 1. Map of Peninsular Malaysia (non-grey shaded area) showing the location of the Kapas and Gemia Islands in the South China Sea. Insets displaying the location of the islands in Terengganu state (top right) and map of the sampling localities (bottom right).

10% formalin (permit no. T-00563-16-17). Fixed specimens were subsequently transferred to 70% ethanol for long-term storage. Voucher materials are deposited at the Universiti Malaysia Terengganu Zoological Collection (**UMTZC**), Universiti Sains Malaysia Herpetological Collection (**USMHC**), La Sierra University Herpetological Collection (**LSUHC**), and La Sierra University Digital Photo Collection (**LSUDPC**). Our data were also augmented with photographic records of species by local resort operators on the islands (Table 1). For taxonomic notes, only species recorded from our surveys were included.

Table 1. List of photographic records of species, all from Gemia Island, by local resort operators catalogued with the LSUDPC voucher code numbers.

LSUDPC voucher no.	Species Name
12641, 12642	*Laticauda colubrina*
12644, 12645	*Eretmochelys imbricata*
12646, 12647, 12649	*Chelonia mydas*

RESULTS

Five species of amphibians from three families, and 16 species of reptiles from 10 families were recorded over the course of the surveys (Table 2). For amphibians, the family Icthyophiidae was represented by one species, while another two families—Rhacophoridae and Microhylidae—have two species each. For reptilians, Gekkonidae is the dominant family, represented by four species, followed by Varanidae, Colubridae, and Cheloniidae with two species each. The other families—Agamidae, Elapidae, Homalopsidae, Pythonidae, Viperidae, and Geoemydidae—had one species each. Based on the International Union

Table 2. Checklist of amphibian and reptile species recorded at Kapas Island (KI) and Gemia Island (GI) with the IUCN status for each species recorded. IUCN categories: NE = Not Evaluated; LC = Least Concerned; NT = Near Threatened; EN = Endangered; CR = Critically Endangered. Voucher: P = photo only; S = sample preserved; O = observed.

Taxa	Species	KI	GI	IUCN	Voucher
CLASS AMPHIBIA					
Order Gymnophiona					
Ichthyophiidae	*Ichthyophis asplenius*	+	–	–	P, S
Order Anura					
Microhylidae	*Kaloula pulchra*	+	–	LC	S
	Microhyla heymonsi	+	–	LC	P, S
Rhacophoridae	*Polypedates leucomystax*	+	–	LC	P, S
	Polypedates discantus	+	–	LC	P, S
CLASS REPTILIA					
Order Squamata					
Suborder Sauria					
Agamidae	*Calotes versicolor*	+	–	LC	P, S
Gekkonidae	*Gehyra mutilata*	+	+	LC	O, S
	Gekko monarchus	+	–	LC	P, S
	Hemidactylus frenatus	+	+	LC	P, S
	Lepidodactylus lugubris	–	+	LC	S
Varanidae	*Varanus nebulosus*	+	–	NT	P
	Varanus salvator	+	+	LC	O, P
Suborder Serpentes					
Colubridae	*Dendrelaphis pictus*	+	–	LC	S
	Lycodon capucinus	+	+	LC	P, S
Elapidae	*Laticauda colubrina*	–	+	LC	P
Homalopsidae	*Hypsiscopus plumbea*	+	–	LC	P, S
Pythonidae	*Malayopython reticulatus*	–	+	LC	P
Viperidae	*Tropidolaemus wagleri*	+	–	LC	S
Order Testudines					
Cheloniidae	*Chelonia mydas*	–	+	EN	P
	Eretmochelys imbricata	–	+	CR	P
Geoemydidae	*Cyclemys dentata*	+	–	NT	P

for Conservation of Nature status (IUCN 2024), one species, *Eretmocehlys imbricata* (Linnaeus, 1766), is Critically Endangered. Another species, *Chelonia mydas* (Linnaeus, 1758), is Endangered, and *Cyclemys dentata* (Gray, 1831) is Near Threatened. Ten species, *Kaloula pulchra* Gray, 1831, *Microhyla heymonsi* Vogt, 1911, *Polypedates leucomystax* (Gravenhorst, 1829), *Hemidactylus frenatus* Duméril & Bibron, 1836, *Varanus salvator* (Laurenti, 1768), *Lycodon capucinus* Boie, 1827, *Hypsiscopus plumbea* (Boie, 1827), *Laticauda colubrina* (Schneider, 1799), *Malayopython reticulatus* (Schneider, 1801) and *Tropidolaemus wagleri* (Boie, 1827) are listed as Least Concern. The remaining species have not been evaluated.

Class Amphibia
Order Gymnophiona

Family Ichthyophiidae

***Ichthyophis asplenius* Taylor, 1965**
Figure 2A

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 7.VIII.2018; Fatihah-Syafiq leg.; 1 subadult, UMTZC1594 • same locality; 11.IV.2012; Evan Quah leg.; 2 larvae, USMHC1284-1285.

Identification. Elongate, cylindrical body; head as wide as body; rounded snout; small eyes; short, blunt tail; dark purple body; bright yellow lateral stripe extending along side of body from head to vent; dentition of upper jaw of specimen not completely intact; 25 premaxillary–maxillary; 19 vomer palatine tooth rows; 15 splenial at lower jaw; 19 dentary tooth rows.

Remarks. Specimens were collected at night hiding under a rotten log near a stagnant pool in the ephemeral stream along Berakit Trail on Kapas Island. Other specimens were observed crawling along the bottom of muddy stagnant pools.

Family Microhylidae

***Kaloula pulchra* Gray, 1831**

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649°E;13.IV.2012; Evan Quah leg.; 1 adult, USMHC1288.

Identification. Limbs stocky, short; snout broadly rounded; tympanum hidden; fingertips expanded, with truncate disks; first finger shorter than second finger; belly granular, whitish and mottled. These characters match the description by Berry (1975).

Remarks. Our specimen was collected near the chalet area on Kapas Island.

***Microhyla heymonsi* Vogt, 1911**
Figure 2B

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 7.VIII.2018; Badli-Sham leg.; 1 ♀, UMTZC 1593 • same locality; 11.IV.2012; Evan Quah leg.; 2 ♂, USMHC1286-USMHC1287.

Identification. Snout rounded; tympanum almost invisible; body with prominent dark band running from snout to inguinal region; a pair of black spots, separated by the vertebral stripe from snout to vent. These characters perfectly match the morphological diagnosis of the species by Berry (1975) and the description of species from Gunung Tebu by Sumarli et al. (2015).

Remarks. We collected all specimens at night on the ground near a stagnant pool in ephemeral stream along Berakit Trail on Kapas Island.

Family Rhacophoridae

***Polypedates discantus* Rujirawan, Stuart, & Aowphol, 2013**
Figure 2C

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 7.VIII.2018; Badli-Sham leg.; 1 ♂ 2 ♀, UMTZC1589, UMTZC 1591, UMTZC 1592.

Identification. Skin of head not co-ossified with skull; vomerine teeth prominent; tips of digits expended into large, round disc bearing circum-marginal grooves; body slender; back thigh with indistinct white dots; tubercles on heel rounded. There is slight variation in the intensity of black blotches on the backs of specimens UMTZC1591 and UMTZC1592. These characters match the description of specimens from southern Thailand (Rujirawan et al. 2013).

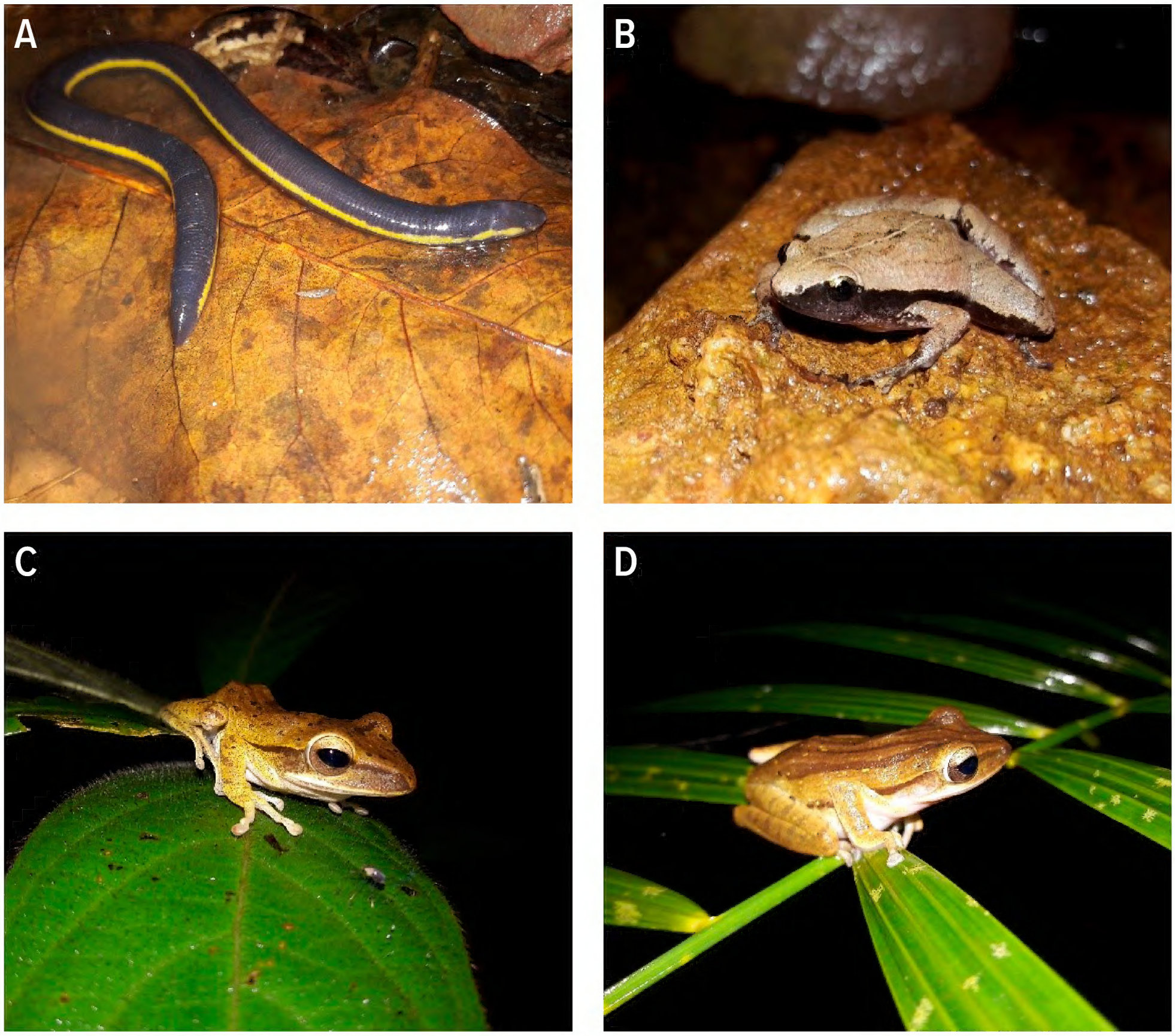

Figure 2. Reptiles found on Gemia and Kapas Islands. **A.** *Ichthyophis asplenius*, Kapas Island. **B.** *Microhyla heymonsi*, Kapas Island. **C.** *Polypedates discantus*, Kapas Island. **D.** *Polypedates leucomystax*, Kapas Island. **E.** *Calotes versicolor*, Kapas Island. **F.** Juvenile of *Gehyra mutilata*, Kapas Island. [Figure continued next page.]

Figure 2, continued. Reptiles found on Gemia and Kapas Islands. **G.** *Gekko monarchus*, Kapas Island. **H.** *Hemidactylus frenatus*, Kapas Island. **I.** *Varanus nebulosus,* Kapas Island. **J.** *Varanus salvator* (LSUDPC12643), Gemia Island. **K.** *Dendrelaphis pictus*, Kapas Island. **L.** *Lycodon capucinus*, Gemia Island. [Figure continued next page.]

Remarks. All but one specimen were seen perched on a tree near the ephemeral stream along the Berakit Trail at night prior to collection. One individual was observed on a bridge on Kapas Island.

***Polypedates leucomystax* (Gravenhorst, 1829)**

Figure 2D

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 7.VIII.2018; Badli-Sham leg.; 1 ♀, UMTZC 1590 • same locality; 11.IV.2012; Evan Quah leg.; 1 ♂, USMHC1289.

Identification. Vomerine teeth in two or more oblique series; head longer than broad; snout rounded, projecting beyond lower jaw; tympanum distinct; tips of digits expended into round discs bearing circum-marginal grooves; heel with tubercles absent; dorsum smooth, with four longitudinal stripes. These characters match the description of specimens from Peninsular Malaysia (Berry 1975) and Tioman Island (Grismer 2011b).

Figure 2, continued. Reptiles found on Gemia and Kapas Islands. **M.** *Hypsiscopus plumbea*, Kapas Island. **N.** *Malayopython reticulatus* (LSUDPC12643), Gemia Island. **O.** *Tropidolaemus wagleri*, Kapas Island. **P.** *Chelonia mydas* (LSUDPC12646), Gemia Island. **Q.** *Eretmochelys imbricata* (LSUDPC12645), Gemia Island. **R.** *Cyclemys dentata* (LSUDPC12639), Kapas Island.

Remarks. We collected our specimens at night. They were sitting on leaves approximately 0.5 m above the ground near stagnant puddles of the ephemeral stream beside Berakit Trail on Kapas Island.

Class Reptilia
Order Squamata
Suborder Sauria

Family Agamidae

***Calotes versicolor* (Daudin, 1802)**
Figure 2E

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 7.VIII.2018; Fatihah-Syafiq leg.; 1 ♂, UMTZC 1586.

Identification. Body laterally compressed; dorsal scales keeled; patagia absent; epidermal spines above tympanum; tympanum naked; vertebral crest composed of enlarged, lanceolate scales extending from occiput to just beyond base of tail; dorsum dull grey. These characters match the description of this species by Grismer (2011a).

Remarks. The collected specimen was found during the day basking on a gate. Another individual was observed basking on a gate near the Kapas Coral Beach Resort.

Family Gekkonidae

***Gehyra mutilata* (Wiegmann, 1834)**
Figure 2F

Material examined. MALAYSIA – **Terengganu** • Gemia Island; 05.2336; 103.2628; 16.X.2020; Evan Quah leg.; 2 ♂, UMTZC 1921-1922.

Identification. Pupils vertical; head, body, limbs and tail covered with granular scales; tubercles absent; body without flaps of skin; first digit of hands and feet short, not vestigial, and claw small and concealed; claws on digits II–V well developed, unsheathed; tail flattened, wider at base, with sharp edges; dorsum light brown; venter beige. These characters agree with the description by Grismer (2011a).

Remarks. This species occurs on both islands, usually on or around man-made structures.

***Gekko monarchus* (Schlegel, 1836)**
Figure 2G

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 8.VIII.2018; Fatihah-Syafiq leg.; 1 ♀, UMTZC 1587.

Identification. Head with granular scales ; tympanum naked; pupils vertical; digits with expanded, subdigital lamellae; body tubercles large; body without flaps of skin, with dark paravertebral blotches; dorsum greyish brown; venter beige. These characters match the description by Grismer (2011a).

Remarks. The specimen was collected at night in a small cave near the beach. This species also occurs in high densities around the chalet areas, in coastal vegetation, and in rocky areas near the beach on Kapas Island.

***Hemidactylus frenatus* Duméril & Bibron, 1836**
Figure 2H

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 8.VIII.2018; Fatihah-Syafiq leg., 1 ♀, UMTZC 1588 • same locality; 11.IV.2012; Evan Quah leg.; 1 ♀, USMHC1290 • Gemia Island; 05.2336°N; 103.2628°E; 10.IV.2012; Evan Quah leg.; 1 ♂, USMHC1295 • same locality as preceding; 16.X.2020; Evan Quah leg.; 2 ♂, UMTZ1923-1924.

Identification. Pupils vertical; tubercles absent; granular scales; no ventrolateral flaps of skin; short first digit on hands and feet; nine expanded, subdigital lamellae on fourth toe; webbing absent; spinose tubercles on the tail; dorsum greyish; venter beige. These characters agreed with the description by Grismer (2011a).

Remarks. This species is very abundant on walls and other man-made structures on both islands.

***Lepidodactylus lugubris* (Duméril & Bibron, 1836)**

Material examined. MALAYSIA – **Terengganu** • Gemia Island; 05.2336; 103.2628; 10.IV.2012; Evan Quah leg.; 1 ♀, LSUHC8360.

Identification. Scales granular; tubercles conical on the lateral margin of tail; body brownish grey, with 5–7 scattered, double, W-shaped brownish markings on dorsum; venter beige. These characters match the description of Grismer (2011a).

Remarks. Our specimen was on a leaf of a tree approximately 2 m off the ground along the beach and chalet area on Gemia Island.

Family Varanidae

***Varanus nebulosus* (Gray, 1831)**
Figure 2I

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 8.VIII.2018; Fatihah-Syafiq leg.; 1 subadult, LSUDPC12648.

Identification. Head relatively narrow; snout relatively long; nostrils elongate, in middle of snout; tail long,

laterally compressed; dorsal body, limbs, and tail black, overlain with fine, light-yellow spots. These characters agree with description by Grismer (2011a).

Remarks. An individual was seen basking on the ground near the chalet area on Kapas Island.

***Varanus salvator* (Laurenti, 1768)**
Figure 2J

Material examined. MALAYSIA – **Terengganu** • Gemia Island; 05.2336; 103.2628; 11.X.2020; Fatihah-Syafiq leg.; 1 adult, LSUDPC12643.

Identification. Head relatively narrow; snout relatively long; nostrils oval, close to tip of snout; neck elongate; tail long; dorsal body with yellow, transverse ocelli; venter dull yellow. These characters match with the description by Grismer (2011a).

Remarks. An individual was sighted during the day basking near the chalet area in Kapas Island. Specimens were commonly observed scavenging around the chalets and along the beach on Gemia Island.

Suborder Serpentes

Family Colubridae

***Dendrelaphis pictus* (Gmelin, 1789)**
Figure 2K

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 11.IV.2012; Evan Quah leg.; 1 ♀, USMHC1292.

Identification. Body long, thin; head scales large, plate-like; eyes large, with round pupils; anal plate divided; body and top of head bronze; postorbital stripe black; preocular white; side of body white stripe, bordered above and below by a black line; tail unbanded. These characters agree with the description by Das (2012).

Remarks. Our specimen was collected at night. It was sleeping on the low branch of a tree along Berakit Trail on Kapas Island.

***Lycodon capucinus* Boie, 1827**
Figure 2L

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 8.VIII.2018; Fatihah-Syafiq leg.; 1 ♂, UMTZC1584 • Gemia Island; 05.2336; 103.2628; 9.X.2020; Evan Quah leg.; 1 ♂, UMTZC1912.

Identification. Body slender, somewhat subcylindrical; snout rounded; head flattened; nuchal band cream-coloured, spotted with brown; dorsum lavender-brown with white reticulum; venter cream. These characters match the description of the species by Das (2012).

Remarks. Our specimen was collected at night in front of a cave near the beach on Kapas Island. The individual from Gemia Island was collected near a chalet at night.

Family Homalopsidae

***Hypsiscopus plumbea* (Boie, 1827)**
Figure 2M

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 11.IV.2012; Evan Quah leg.; 1 ♀, USMHC12932 • same locality; 7.VIII.2018; Fatihah-Syafiq leg.; 2 juveniles, UMTZC1583, UMTZC1585.

Identification. Body robust, subcylindrical; ventral scaless 127–132; upper labials 2 and 3 contact loreal; mid-body with 19 scale rows; internasal scale single, not contacting loreal scale; dorsum uniform grey and dorsolateral region orangish; venter cream. These characters fit the description of the species by Murphy and Voris (2014).

Remarks. Our specimens were collected at night in the stagnant pools of the ephemeral stream along Berakit Trail on Kapas Island.

Family Pythonidae

***Malayopython reticulatus* (Schneider, 1801)**
Figure 2N

Material examined. MALAYSIA – **Terengganu** • Gemia Island; 05.2336; 103.2628; 9.X.2020; Evan Quah leg.; 1 adult, LSUDPC12640.

Identification. Body large, relatively elongate; head distinct from neck; infralabial scales with pits; dorsum brown, with dark, rhomboidal markings; top of head from snout to nape with black median line; posterior corner of eyes to angle of jaw with black postorbital stripe; belly yellow, with small, brown spots. These characters fit the description by Das (2012).

Remarks. This species was found at the forest edge near the chalets on Gemia Island.

Family Viperidae

***Tropidolaemus wagleri* (Boie, 1827)**
Figure 2O

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 12.IV.2012; Evan-Quah leg.; 1 ♂, USMHC1294.

Identification. Head broad, flat; tail slightly laterally compressed; head scales strongly keeled; body green, with small red-and-white spots; thin, white and thick red stripes running through eyes from loreal scales to back of head just before neck. These characters agree with the description of this species by Das (2012).

Remarks. Our specimen was collected at night. It was coiled on low vegetation along the Berakit Trail on Kapas Island.

Order Testudines

Family Geomydidae

***Cyclemys dentata* (Gray, 1831)**
Figure 2R

Material examined. MALAYSIA – **Terengganu** • Kapas Island; 05.2190, 103.2649; 12.IV.2012; Evan-Quah leg.; 1 adult, LSUDPC12639 • same locality; 7.VIII.2018; Aqmal-Naser leg.; 1 adult, 1 juvenile, observation.

Identification. Carapace oval, depressed, tricarinate, dark brown; plastron yellow, with dark, radiating lines; forehead speckled, with enlarged scales. These characters agree with the morphological description by Auliya (2007).

Remarks. Three individuals of *C. dentata* (two adults and a juvenile) were observed at night in stagnant pools in the ephemeral stream along Berakit Trail on Kapas Island.

DISCUSSION

Twenty-one amphibian and reptile species were recorded from Kapas and Gemia Islands, including one caecilian, four frog, seven lizard, six snake, and three turtle species. Our results serve as baseline data of the herpetofauna of these islands. However, our data may not represent the complete species richness of the herpetofauna of these islands due to the short duration of our survey. Subsequent surveys should include unexplored areas on the islands and use additional methods, like pitfall traps. This method may detect more elusive species such as semifossorial skinks and snakes (Grismer et al. 2014c, 2016, 2018; Nur Amalina et al. 2017; Syafiq et al. 2023, 2024) that are rarely encountered through visual encounter surveys.

Habitat quality has profound importance in influencing species richness on small islands (Hortal et al. 2009). The presence of microhabitats such as an ephemeral stream, boulders, and vegetation provide refugia for forest-dwelling species to escape from human disturbance (Grismer et al. 2004c). Riparian species such as *Polypedates leucomystax*, *Polypedates discantus*, *Ichthyophis asplenius*, *Microhyla heymonsi*, *Cyclemys dentata* and *Hypsiscopus plumbea* were confined to the vicinity of water, such as puddles in the ephemeral stream on Kapas Island. The presence of a few juveniles of *H. plumbea* and a juvenile of *C. dentata* at this habitat suggests that the ephemeral stream provides shelter and might be the only ideal breeding site for these riparian species on the island. The discovery of *C. dentata* on Kapas Island is the first record of a freshwater chelonian on any of the islands of Terengganu, despite Kapas Island being small and lacking permanent freshwater streams, unlike some larger islands with permanent freshwater streams, such as Perhentian Besar Island. The proximity of Kapas Island to the mainland might explain the presence of this species.

Islands themselves are important ecological habitats due to their sensitivity (e.g. Whittaker 1995; Theng et al. 2020). Habitat deterioration on islands may threaten the survival of their native terrestrial species with highly restricted distributions (Brook et al. 2003; Fordham and Brook 2010). Forest-dependent species and those with low thermal tolerance will likely suffer immediate decline from these environmental changes (Nowakowski et al. 2017). Conversely, adaptable species will survive and dominate, potentially leading to a process called stochastic biotic homogenization (McKinney and Lockwood 1999; Rosenbland and Sax 2017). The development of tourist accommodations should be limited on the island to preserve pristine areas.

Many of the recorded island reptile species are human commensals, like the house geckos *Gehyra mutilata*, *Hemidactylus frenatus*, and *Gekko monarchus*. *Gekko monarchus*, the most dominant species on Kapas Island, co-occurred with *H. frenatus* on man-made structures like restaurant walls, but it lives in natural habitats, like coastal vegetation and boulders along rocky shorelines and even in small caves near the beach.

We recorded both *H. frenatus* and *L. lugubris* on Gemia Island. Grismer et al. (2011b) noted that co-occurrence of these two species in the small islands in the Seribuat Archipelago was rather uncommon due to niche competition, and, where they co-occur, *H. frenatus* is present at extremely high densities and occupies the island's interior, while *L. lugubris* is restricted to the island's periphery where it occurs among boulders in the intertidal zone. We made similar observations on Gemia Island, where *H. frenatus* was extremely common on buildings, rocks, and vegetation throughout the island, but the single *L. lugubris* was found on seaside vegetation. The abundance of these geckos on Kapas and Gemia Islands in turn may provide the prey-base for predators such as *Dendrelaphis pictus*, *Lycodon capucinus*, and *Tropidolaemus wagleri*. On Gemia Island, workers report *L. capucinus* regularly entering chalets and other buildings, where they probably hunt for geckos.

The presence of *C. dentata* and *V. nebulosus*, both classified as Near Threatened by the IUCN (2024), highlights the need for protection of the forested interior of Kapas Island. To date, most of the tourist facilities are developed along the beaches by clearing coastal vegetation. However, we are seeing local operators begin to clear plants near their chalets and motels for various purposes. Not surprisingly, soon, more and more permanent buildings will be erected in these areas to cater to the influx of tourists. This may eventually encroach pristine areas which are currently occupied by species not strongly associated with humans. Although Kapas Island is classified as one of the Terengganu's marine parks, *Chelonia mydas* and *E. imbricata*, which are listed as Endangered and Critically Endangered, respectively, face the risk of entanglement in fish nets outside the marine park area. Therefore, cooperation and awareness among the fishermen is also essential to protect these species.

Future surveys of unexplored and less-studied islands will enhance our knowledge of Terengganu's offshore island herpetofauna. Such studies are critically needed because islands face multiple threats from tourism, which lead to pollution and deforestation (Gazi et al. 2013; Graham et al. 2017). Ultimately, the gathered information can inform conservation decisions to safeguard these island ecosystems and prevent irreversible environmental damage and biodiversity loss.

ACKNOWLEDGEMENTS

We thank Universiti Malaysia Terengganu for the equipment provided to conduct this study. The Tuanku Canselor Scholarship, generously funded by Universiti Malaysia Terengganu, greatly supported the first author (MFS) throughout this study. ESHQ would like to thank Mr. Wee Chin Teng and the team at Gem Island Resort and Spa for their generosity and help with the surveys on the island. The Department of Wildlife and National Parks is dully acknowledged for permission to conduct this study (permit no. T-00563-16-17). We also give thanks for the research pass (40/200/19 SJ.1105) that was issued to LLG by the Economic Planning Unit, Prime Minister's Department, Malaysia. We thank the anonymous reviewers for helpful comments.

ADDITIONAL INFORMATION

Conflict of interest statement

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

Funding

This study received no specific funding.

Author contributions

Conceptualization: MFS, BHBS, ABA. Data curation: MFS, BHBS, MAN, MFA, ESHQ, LLG, ABA. Investigation: MFS, BHBS, MAN, MFA, ESHQ. Methodology: MFS, BHBS, MAN, MFA, ESHQ, LLG, ABA. Resources: MFS, BHBS, MAN, MFA, ESHQ, LLG, ABA. Supervision: ESHQ, LLG, ABA. Visualization: MFS, BHBS, ESHQ. Writing – original draft: MFS. Writing – review and editing: MFS, BHBS, ESHQ, LLG, ABA.

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Data availability
All data that support the findings of this study are available in the main text.

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